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(54) Gas or air flow regulators

(57) Apparatus is described for regulating the flow of gas or air under pressure between two regions (A,B). The apparatus comprises a wall (10) which separates the two regions (A,B) and which has an aperture (12) through which gas or air flow is regulated by a regulating flap (14). The apparatus is characterised by the provision of irregularities on one or more surfaces (22,24) adjacent to which the air or gas flows, the irregularities serving to reduce the generation of noise.

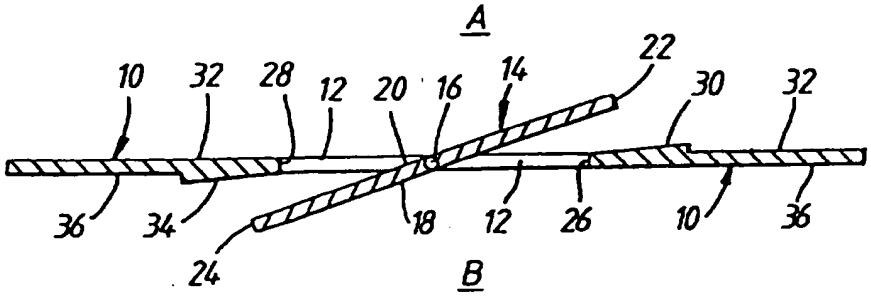

Fig.1

EP 0 690 272 A2

Description

The invention relates to gas or air flow regulators.

More specifically, in a first aspect the invention relates to a regulating flap for variably obstructing an aperture to control the flow of gas or air therethrough. In a second aspect, the invention relates to a regulating flap for variably obstructing an aperture to control the flow of gas or air along a flow path therethrough, comprising a surface formation positioned between the flap and the edge of the aperture and in the flow path, the surface formation operating to reduce noise caused by such flow. In a third aspect, the invention relates to apparatus for regulating the flow of gas or air under pressure along a flow path extending between first and second regions, comprising wall means separating the two regions, an aperture defined in the wall means and connecting the regions and through which the flow path passes, a regulating flap movable between a closed position in which it closes the aperture to prevent the gas or air flow therethrough and a plurality of open positions in which the aperture is opened to respectively different extents to permit the flow along the flow path, and a surface formation positioned in the flow path, the surface formation operating to reduce noise caused by such flow.

Such flaps and apparatus are known, for example, from US-A-4 249 571. In this known arrangement, the edge of a flap valve carries a substrate supporting a large number of closely adjacent fibres forming a short nap pile. These are said to prevent reflection of air waves, thereby serving to reduce noise.

The invention aims to improve noise reduction.

Therefore, in accordance with the first aspect of the invention, the known regulating flap is characterised by one or more predetermined irregularly formed surfaces adjacent to which the gas or air flows when the aperture is nearly completely obstructed by the flap, whereby to reduce noise caused by such flow.

According to the second aspect of the invention, the known regulating flap is characterised in that the surface formation comprises means defining one or more projections which are so positioned in the flow path as to provide respective modifications of the local flow rate whereby to cause a corresponding local change in the frequency of the noise produced.

According to the third aspect of the invention, the known apparatus is characterised in that the surface formation comprises means defining one or more projections which are so positioned in the flow path as to provide respective modifications of the local flow rate whereby to cause a corresponding local change in the frequency of the noise produced.

Embodiments of the invention to be described in more detail below are for regulating air flow in the ventilating, heating or air-conditioning system of a motor vehicle.

Air flow regulators embodying the invention will now be described, by way of example, making reference to the accompanying diagrammatic drawings, in which:

Figure 1 is a cross-section through one of the air flow regulators;

Figure 2 is an enlarged perspective view of part of the periphery of the regulating flap of the air flow regulator of Figure 1;

Figure 3 corresponds to Figure 2 but shows modifications; and

Figure 4 is a plan view of another regulating flap for the air flow regulator of Figure 1.

As shown in Figure 1, an air flow regulator includes a wall 10 separating a region of higher air pressure A from a region of lower air pressure B. The wall has an aperture 12 connecting the two regions A,B, and through which air can flow under control of a regulating flap 14. The regulating flap 14 is pivotably mounted on the wall 10 so as to be rotatable about an axle 16 which lies centrally within the flap 14 and centrally within the aperture 12. The angular position of the flap thus determines the extent to which the aperture 12 is open.

The regulating flap 14 is rectangular having first and second planar side surfaces 18,20 interconnected by first and second longer edges 22,24 and two shorter edges which are not shown and are perpendicular to the edges 22,24.

The aperture 12 is also rectangular and is bordered by first and second longer, planar edges 26,28 and two shorter planar edges which are not shown and are perpendicular to the edges 26,28 and pivotably support the ends of the axle 16. When the regulating flap 14 closes the aperture 12, edge regions of its surfaces 18 and 20 seal against seating surfaces 30 and 34 provided on the sides 32 and 36 of the wall 10 and respectively facing regions A and B. The shorter edges of the flap 14, perpendicular to the edges 22 and 24, may be provided with flexible seals or are otherwise arranged so as to seal against the corresponding edges of the aperture when the flap 14 is in the closed position.

Air flow through the aperture 12 from the region of higher air pressure A to the region of lower air pressure B is regulated by rotating the regulating flap 14, thereby obstructing the aperture 12 to a greater or lesser extent. Thus the aperture 12 is closed by rotating the regulating flap 14 clockwise from the intermediate position shown in Figure 1 bringing edge regions of the first and second side surfaces 18,20 of the regulating flap 14 into sealing contact with the first and

second seating surfaces 30,34 respectively. To fully open the aperture 12, the regulating flap 14 is rotated anticlockwise from the position shown in Figure 1 until the regulating flap 14 lies normal to the wall 10. Intermediate extents of air flow are obtained by positioning the regulating flap 14 in respective positions intermediate the closed and fully open position.

In intermediate positions of the flap 14, when its first and second side surfaces 18,20 are closely spaced from the first and second seating surfaces 30,34, it is found that there is a tendency for the air flow to produce a potentially annoying, shrill noise. This is believed to be caused by turbulence created when the air flowing through the slightly open aperture meets the relatively small air in the region B. The restricted opening causes the air flow to be accelerated, thus increasing the acoustic pressure and the resulting noise.

In order to prevent or minimise this noise, the edges 22,24 of the flap 14 are formed with irregular convex and concave curves, as shown in Figure 2, so as to provide a series of outwardly extending projections 38 at the periphery of the regulating plate 14. This arrangement is found to reduce the production of the noise when air flows through the regulator in the intermediate position described above. Noise reduction is found to be optimised when the dimensions W1, W2, W3 are all different and likewise when the dimensions 11, 12, 13 are all different.

The noise which the air flow tends to produce is particularly annoying when it is concentrated in a restricted frequency range. The irregular projections 38 provide a number of different flow rates, each corresponding to a particular frequency, and modify the turbulence. In this way, the irregular projections can be designed to spread the frequencies of the noise caused by the total air flow over a larger frequency range so that the noise becomes indistinguishable from the general background or "white" noise. Because the total flow is spread over a much larger frequency range, the magnitude at each frequency within the range is greatly reduced. In the absence of the surface irregularities, the air flow would be in the form of a single flow, thus producing a noise having a single frequency or restricted range of frequencies and thus particularly annoying.

Instead of the irregular edges 22,24 described above with reference to Figure 2, reduction of noise can be achieved by providing other arrangements of irregular surfaces on the regulating flap 14.

Two such arrangements are shown by way of example in Figure 3. Here, the amount by which each projection or irregularity 38 extends outwardly from the flap 14 varies with the thickness of the flap. In addition, the flap is provided with small holes 40 which have various cross-sections as shown. The irregularities 38, as shown in the Figure, and the holes 40, may be used in conjunction with each other as shown or separately. They have the same minimising effect on the noise as explained above in relation to Figure 2.

The holes 40 are positioned closer to the edge of the flap 14 than the region 41 indicated in Figure 3 which is the region where the surface of the flap 14 contacts the edge of the aperture 12 when closing it.

Advantageously, the irregularly formed edges are formed in flexible sealing edge regions extending around the periphery of the regulating flap 14 as shown in Figure 4. Here the flap 14 comprises a rigid central portion or panel 42 and a surrounding flexible, resilient relatively soft lip 44 in whose edges are formed the irregular projections 38. The provision of the irregular projections in the softer material is found to provide greater noise reduction. Because of the flexibility of the lip 44, and its slight deformation under pressure, the gap through which the air flows is slightly increased. The air speed is therefore slightly reduced, thus providing reduction of acoustic pressure and further noise reduction. The soft lip 44 is advantageously made of foamed or cellular material to increase these effects.

The soft lip 44 is also advantageous in that it provides better sealing around the aperture 12 when the flap 14 is in the closed position. In addition, during closure of the flap 14 the soft lip 44 provides less abrupt interruption of the air flow and, again, reduced noise.

It will be appreciated that although the provision of irregular surfaces and the use of an elastically deformable lip 44 to reduce noise production have been described above with reference to a rectangular regulating flap 14 pivotably mounted within a rectangular aperture 12, these features can be applied to air flow regulators having other configurations. Other such regulators may, for example, use regulating flaps and apertures having other shapes, other means of mounting the regulating flap adjacent the wall, and two or more regulating flaps each variably obstructing part of the same aperture.

It will also be appreciated that the irregular edge projections can be provided on the edges of the aperture instead of or in addition to providing them on the regulating flap 14.

Claims

1. A regulating flap (14) for variably obstructing an aperture (12) in order to control the flow of gas or air therethrough, characterised by one or more predetermined irregularly formed surfaces (38,40) adjacent to which the gas or air flows when the aperture (12) is nearly completely obstructed by the flap (14), whereby to reduce noise caused by such flow.

2. A regulating flap (14) for variably obstructing an aperture (12) to control the flow of gas or air along a flow path therethrough, comprising a surface formation (38) positioned between the flap and the edge of the aperture and in the flow path, the surface formation (38) operating to reduce noise caused by such flow, characterised in that the

surface formation comprises means defining one or more projections (38) which are so positioned in the flow path as to provide respective modifications of the local flow rate whereby to cause a corresponding local change in the frequency of the noise produced.

3. A flap according to claim 2, characterised in that the projections (38) extend outwardly from the flap (14) and have a multiplicity of sizes lying within a predetermined range of sizes.

4. A flap according to claim 2 or 3, characterised in that the surface projections (38) are formed in an elastically deformable region (44) of the flap.

5. A flap according to claim 4, characterised by a central substantially rigid panel (42) and an elastically deformable border (44) extending therearound and constituting the said deformable region.

6. A flap according to any one of claims 2 to 5, characterised in that each projection (Figure 2) extends away from the general plane of an edge of the flap by a constant amount which is different from the respective constant amounts of the adjacent said projections.

7. A flap according to any one of claims 2 to 5, in which at least one of the projections (38, Figure 3) extends away from the general plane of an edge of the flap by an amount varying in a predetermined manner along the thickness dimension of the edge.

8. A flap according to any preceding claim, characterised by one or more holes (40) extending at least partially through the flap adjacent an edge thereof.

9. Apparatus for regulating the flow of gas or air under pressure along a flow path extending between first and second regions (A,B), comprising wall means (10) separating the two regions (A,B), an aperture (12) defined in the wall means (10) and connecting the regions (A,B) and through which the flow path passes, a regulating flap (14) movable between a closed position in which it closes the aperture (12) to prevent the gas or air flow therethrough and a plurality of open positions in which the aperture (12) is opened to respectively different extents to permit the flow along the flow path, and a surface formation (38) positioned in the flow path, the surface formation (38) operating to reduce noise caused by such flow, characterised in that the surface formation (38) comprises means defining one or more projections (38) which are so positioned in the flow path as to provide respective modifications of the local flow rate whereby to cause a corresponding local change in the frequency of the noise produced.

10. Apparatus according to claim 9, characterised in that the projections (38) extend from and outwardly of the flap (14) and have a multiplicity of sizes lying within a predetermined range of sizes.

11. Apparatus according to claim 9 or 10, characterised in that the surface projections (38) are formed in an elastically deformable region (44) of the flap.

12. Apparatus according to claim 11, characterised by a central substantially rigid panel (42) and an elastically deformable border (44) extending therearound and constituting the said deformable region.

13. Apparatus according to claim 9, characterised in that the surface projections are formed in an edge of the aperture (12).

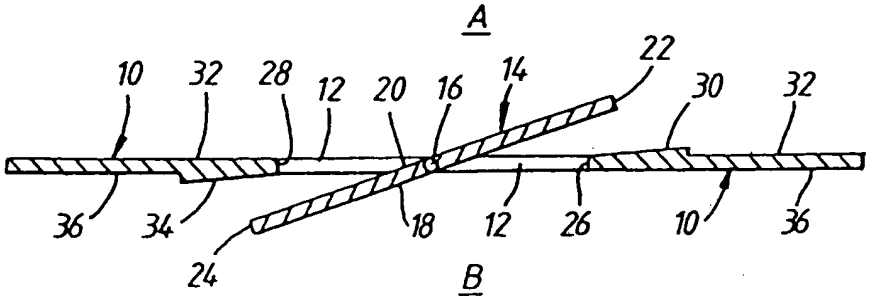
A
10
32
28
12
20
16
14
22
30
32
36
34
18
12
26
10
36
24
B

Fig.1

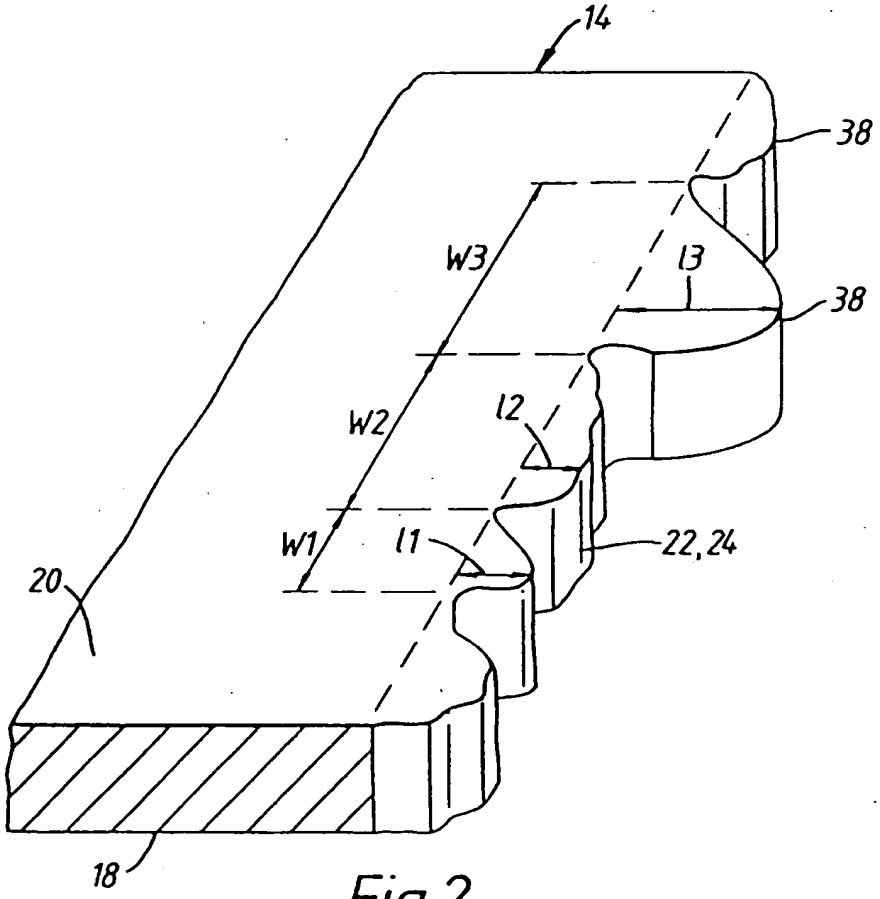
14
38
W3
l3
38
W2
l2
W1
l1
22,24
20
18

Fig.2

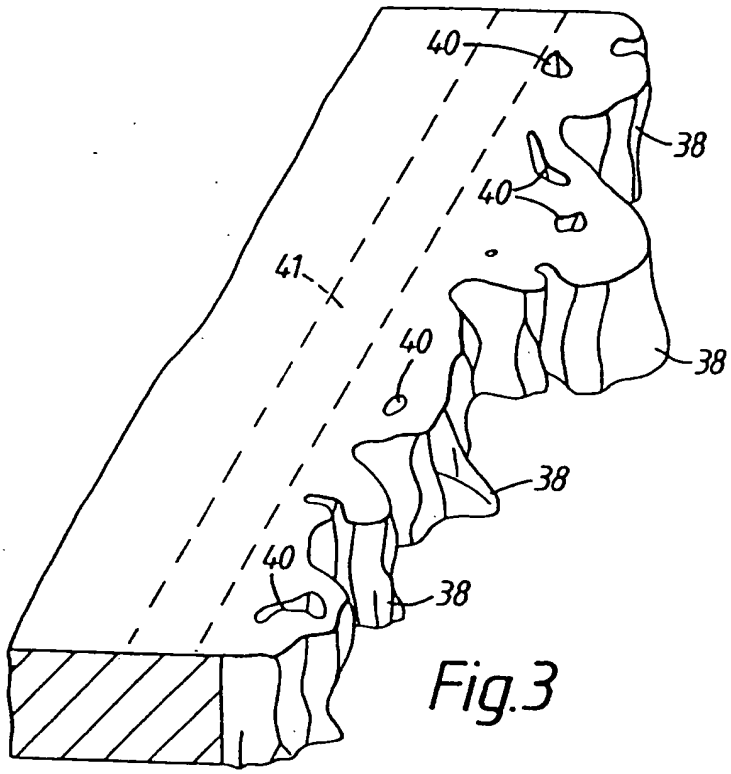

Fig.3

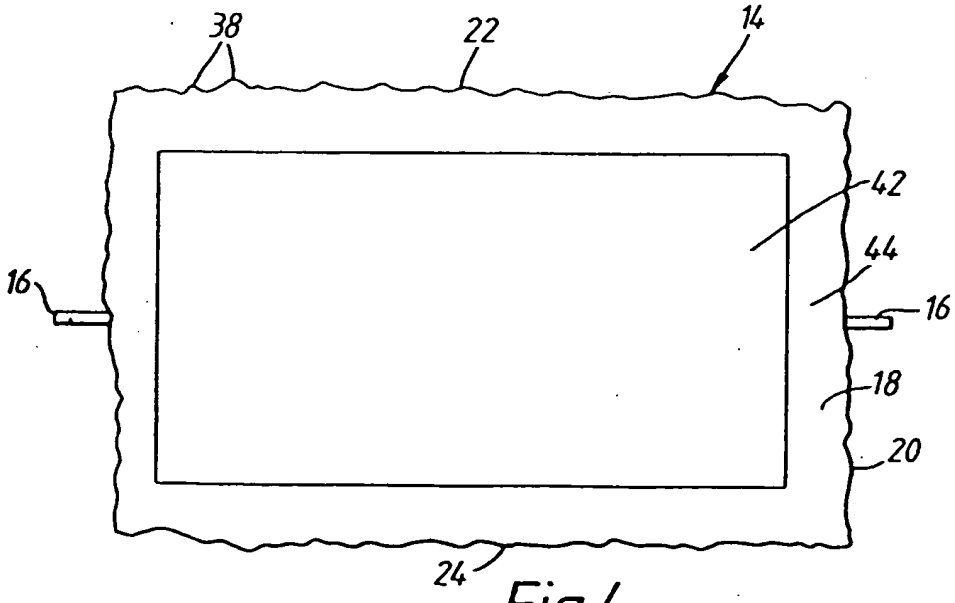

Fig.4